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clear all;

% Parameters
Tend = 1.0;
b = 10.0;
c = b^2/4;
h2 = 0.05;

A2 = 1 + b/2 * h2 + c/4 * h2^2;
B2 = 1 + b/2 * h2 - c/4 * h2^2;
C2 = h2;
E2 = (1 - b/2 * h2)/(1 + b/2 * h2);
F2 = (-c/2 * h2)/(1 + b/2 * h2);

% Initialization
i = 1;
t(i) = 0.0;
y1(i) = 1;
y2(i) = 0;
Eh2 = zeros(1000,1);

% Exact solution
tt = linspace(0, Tend, 1000);
ye = (1 + b/2*tt).*exp(-b/2*tt);

% Recursive scheme for Theta method (h2)
while (t(i) + h2 < Tend + 1.e-12)
    y1(i+1) = B2/A2 * y1(i) + C2/A2 * y2(i);
    y2(i+1) = E2 * y2(i) + F2 * y1(i) + F2 * y1(i+1);
    Eh2(i+1,1) = abs(y1(i+1) - ye(i+1));
    t(i+1) = t(i) + h2;
    i = i+1;
end

% Compare numerical solution with exact solution
figure(2);
plot(tt, ye, '-', t, y1, 'r-o');
legend('Exact solution', 'Theta method (\Theta = 0.5) solution (h = 0.05)', 'Location', 'best');
xlabel('t');
ylabel('y(t)');

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